

Fractionation apparatus and method in fractionation
of stock in a paper machine or equivalent

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The invention relates to a fractionation apparatus and a method in fractionation of stock in a paper machine or equivalent.

10 The use of both a centrifugal cleaner and a screen as a fractionation device is known in connection with both the treatment of stock and the short circulation. A combination of these in stock cleaning is also known, but the combination has not been known in the short circulation in the manufacture of a layered paper product.

15 A drawback of the hydrocyclone fractionation in the short circulation is the poor strength of the reject fraction and, in processes that include coating, the fairly high pigment content. A drawback of the screen fractionation before centrifugal cleaning is the separation of the centrifugal cleaning of the process into two parts and a drawback of the screen fractionation after the centrifugal cleaning is the difference in the consistency of accept and reject from the screen. At a stock reject
20 ratio of 1/3, the screen reject consistency is about double as compared with that of the accept if a good fractionation result is desired. In that case the consistency of the accept is probably too low for web forming or the consistency of the centrifugal cleaning before the screen then rises to so high a level that the cleaning result is poor.

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In the invention, hydrocyclone fractionation and screen fractionation are combined in the short circulation of a layering paper machine or equivalent, so that the drawbacks are diminished with respect to separate techniques. In one advantageous coupling mode of the invention, a fractionating screen has been
30 placed on the accept side of the first stage of centrifugal cleaning, and the reject of the fractionating screen is passed either to the feed or to the accept of cleaners of

the second stage. The centrifugal cleaning has been coupled according to the double accept principle, so that two fractions to be layered are obtained. The reject ratio of the screen can be kept smaller because of hydrocyclone fractionation, so that the consistency of the screen accept cannot drop to too low a level.

The fractionating short circulation in accordance with the invention can be accomplished at costs comparable to those of the normal single layer technique since, in the arrangement, separate machine screens are not necessarily needed for the fraction. The first fraction is typically passed to the surface layers. The system makes it possible to apply all deaeration alternatives: stock deaeration, wire water deaeration or merely a wire pit.

Within the scope of the invention, an embodiment is also feasible in which a fractionation screen has been disposed before a centrifugal cleaning plant and before a centrifugal cleaner of the first stage of the centrifugal cleaning plant.

The fractionation apparatus and the method in fractionation of stock in a paper machine or in equivalent fractionation of stock in accordance with the invention are characterized in what is stated in the claims.

In the following the invention will be described with reference to some advantageous embodiments of the invention illustrated in the figures of the appended drawings, but the invention is not meant to be exclusively limited to said embodiments.

Figure 1A shows an embodiment of the invention in which the stock fractionation apparatus in a paper machine or equivalent comprises a fractionation screen in connection with an accept line of a centrifugal cleaner in a first centrifugal cleaning stage of a centrifugal cleaning plant.

Figure 1B shows an embodiment in which a two-layer web is formed and which embodiment otherwise corresponds to the embodiment of Fig. 1A.

Figure 2 shows an embodiment of the invention which corresponds to the embodiment of Fig. 1A otherwise but in which device arrangement two accepts are taken out as accept from the upper part of a hydrocyclone cone of a centrifugal cleaner in a second centrifugal cleaning stage of a centrifugal cleaning plant, the innermost accept forming a light reject, which is passed back to the feed of the centrifugal cleaning plant.

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Figure 3A shows an embodiment of the invention in which a fractionation screen has been placed on the feed side of a first centrifugal cleaning stage of a centrifugal cleaning plant.

15 Figure 3B shows an embodiment in which a two-layer web is formed and which embodiment otherwise corresponds to the embodiment of Fig. 3A.

Figure 4 shows a further embodiment of the fractionation apparatus in accordance with the invention.

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Figure 5 shows a further embodiment of the fractionation apparatus in accordance with the invention.

Figure 6A shows, in principle, the operation of a centrifugal cleaner of a centrifugal cleaning plant.

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Figure 6B shows the operation of principle of a screen.

Figure 7 shows an embodiment of the invention in which two different pulps are used as raw material of paper, one of said pulps being fractionated in the short circulation.

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Figure 8 shows an embodiment which uses two different pulps and in which both pulps are fractionated.

5 Fig. 1A shows the first advantageous embodiment of the invention in which, in accordance with the invention, hydrocyclone fractionation and screen fractionation have been combined in the short circulation 10 of a paper machine or equivalent. In the embodiment of Fig. 1, wire water is passed from a wire section V of the paper machine into a wire pit 11 along a line 12. The wire pit 11 is additionally supplied with fresh water and thick stock through lines 13a₁, 13a₂. There is a line 14 from the wire pit 11 to a first centrifugal cleaning stage Po_I of a centrifugal cleaning plant 15. The line 14 comprises a pump P₁ for pumping stock to the first centrifugal cleaning stage Po_I of the centrifugal cleaning plant 15. Thus, the line 14 serves as a stock feed, or inlet, line for a first centrifugal cleaner 15a₁ of the centrifugal cleaning plant 15.

The centrifugal cleaners 15a₁, 15a₂ of the centrifugal cleaning plant 15 are formed of a conical structure, to the upper part of which the feed stock to be treated is passed and in which the inlet line 14 joins, for example, the centrifugal cleaner 20 15a₁ of the first stage Po_I tangentially, so that the flow is caused to spiral inside the centrifugal cleaning cone such that the heaviest particles are separated due to the effect of the centrifugal force to the periphery of the structure and drop along a spiral path downward inside the cone to a reject line 16 and lighter particles are separated from the middle to an accept line 17. The centrifugal cleaner 15a₁ forms 25 the first fractionation stage.

The figures refer to lines by which are meant pipelines or ducts through which a stock flow is conducted. When centrifugal cleaning stages of a centrifugal cleaning plant are mentioned in this application, the upper stages refer to those 30 centrifugal cleaners which treat the stock first and the lower stages refer to the subsequent cleaners, to which a reject flow from upper stages is also passed.

Thus, in the embodiment of Fig. 1A, the rejected stock material is passed to the reject line 16 and the accepted stock is passed to the accept line 17 from the centrifugal cleaner 15a₁ of the first centrifugal cleaning stage Po_I of the centrifugal cleaning plant 15. The stock is passed further along the accept line 17 in accordance with the invention to the second fractionation stage, to a fractionation screen 21 in which the stock is fractionated according to the basic principle of screening, i.e. by performing mechanical separation of the stock, for example, through a wire mesh structure so that the accepted stock is passed as accept to a line 22 and further to a first inlet header J₁ of a paper machine headbox manufacturing multi-layer paper.

In the embodiment of Fig. 1A, the stock passed along the line 22 is branched into branch pipelines 22a₁, 22a₂ connected to inlet headers J₁ and J₃ which make the surface layers of the multi-layer paper. The line 22 comprises a headbox feed pump P₃.

In the embodiment of Fig. 1A, the stock portion not accepted in the fractionation screen 21, i.e. reject, is passed along a line 23 directly to a second-fraction line 20, i.e. to an accept line 20 of a second centrifugal cleaning stage Po_{II}.

The reject line 16 from the first stage Po_I of the centrifugal cleaning plant 15 joins a line 18, which comprises a stock feed pump P₂ and which line 18 is an inlet line to a centrifugal cleaner 15a₂ of the second centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant 15. The rejected stock portion is passed from the centrifugal cleaner 15a₂ to a reject line 19 and the separated, accepted, so-called accept portion is passed to the accept line 20 and further to a middle inlet header J₂ of the headbox to form the second fraction and to form the middle layers of the multi-layer paper. The accept line 20 comprises a headbox feed pump P₄.

The reject passed from the fractionation screen 21 is additionally passed along a line 24 to the line 18 between the first centrifugal cleaning stage Po_I and the second centrifugal cleaning stage Po_{II} , in which line the stock is mixed with the stock passed to the reject line 18 and with dilution water (lv) passed along the line
5 and introduced into it. The line 18 comprises a pump P_2 .

Within the scope of the invention an embodiment is also feasible in which reject from the fractionation screen 21 is passed to the line 23 and/or to the line 24.

10 Fig. 1B shows an embodiment in which a line 22 of a first fraction ends directly in an inlet header J_1 to form one surface layer of a two-layer web, such as a two-layer paper. A line 20 forms the other surface layer of the two-layer web, such as a two-layer paper, the line 20 joining an inlet header J_2 of a multi-layer headbox.

15 Fig. 2 shows an embodiment of the invention in which a centrifugal cleaner $15a_2$ of a second centrifugal cleaning stage Po_{II} comprises a first accept outlet 20 and a so-called second accept outlet 201. The first accept outlet 20 is taken from the upper part of the cone and the second accept outlet 201 is also taken from the upper part of the cone, from a location further in than the first accept outlet. Thus,
20 the second accept outlet 201 comprises finer and lighter stock than the first accept outlet 20. Said second accept outlet produces a so-called light reject, which is passed along the line 201 to the inlet side of a centrifugal cleaning plant 15, to an inlet line 14 of its first centrifugal cleaning stage Po_I , advantageously to the suction side of a pump P_1 . Otherwise, the embodiment shown in the figure
25 corresponds to the preceding embodiments. Reject from a fractionation screen 21 can be passed either directly to the accept line 20 of the second centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant 15 along a line 23 / or said reject can be passed along a line 24 to a line 18, to the suction side of a pump P_2 , which line 18 is an inlet line to the centrifugal cleaner $15a_2$ of the second
30 centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant 15. Thus, the reject

passed from the fractionation screen 21 can be passed either to the line 23 or to the line 24 or to both.

5 Stock is passed through an accept line 22 of the screen 21 and through branch lines 22a₁ and 22a₂ to inlet headers J₁ and J₂ of a multi-layer headbox 100 so as to form the surface layers of a multi-layer web. Stock is passed through the line 20 to a middle inlet header of the multi-layer headbox 100 so as to form the middle layer of the multi-layer web. The line 20 comprises a headbox feed pump P₄ and the line 22 comprises a headbox feed pump P₃.

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Within the scope of the invention, an embodiment is feasible in which the first fraction forms merely one layer of a multi-layer web and the second fraction forms merely the other layer of the multi-layer web. Thus, in said embodiment, a two-layer web is formed, so that one surface layer of the web is formed from the fractionation fraction supplied through the line 22 and the other surface layer of the two-layer web is formed from the fraction supplied through the line 20. The embodiment otherwise corresponds to the embodiment shown in Fig. 2.

15 Fig. 3A shows an embodiment of the invention in which a fractionation screen 21 is situated in a line 14 between a first centrifugal cleaning stage Po_I of a centrifugal cleaning plant 15 and a wire pit 11 on the pressure side of a pump P₁. The fractionation screen 21 fractionates the stock in the line 14 such that the accepted accept that has passed through the screen is passed from the fractionation screen 21 to a line 14a₁, which is an inlet, or feed, line of a centrifugal cleaner 25 15a₁.

The fractionation screen 21 is disposed on the pressure side of the stock feed pump P₁ in the feed, or inlet, line 14 of the centrifugal cleaner 15a₁ of the centrifugal cleaning stage Po_I. The accept line 14a₁ of the fractionation screen 21 has been connected to form an inlet line for the centrifugal cleaner 15a₁ of the first centrifugal cleaning stage Po_I of the centrifugal cleaning plant 15. Reject from the

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fractionation screen 21 is passed to a feed line of another centrifugal cleaning stage of said centrifugal cleaning plant 15, in the figure to a feed line 18 of a second centrifugal cleaning stage Po_{II} , and/or directly to form a second fraction by joining a reject line 22 to an accept line of a centrifugal cleaner 15a₂ of another centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant, in the figure to an accept line 20 of the second centrifugal cleaning stage Po_{II} .

Reject from the fractionation screen 21 is passed along the line 23 to the accept line 20 of the centrifugal cleaner 15a₂ in the second centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant 15 or through the line 24 to the line 18 which is situated after a reject line 16 of the centrifugal cleaner 15a₁ of the first stage Po_I and which is connected with the centrifugal cleaner 15a₁ through the reject duct 16.

Thus, within the scope of the invention, embodiments are feasible that the reject is passed either to the line 18 or to the line 20 or both to the line 18 and to the line 20. The line 18 may be supplied with dilution water (lv).

An accept line 17 branches to branch lines 17a₁ and 17a₂ that pass the stock via a headbox feed pump P₃ to inlet headers J₁ and J₃ of a headbox 100. The second-fraction line 20 is connected with a middle inlet header J₂ of the headbox 100 to form the middle layer of the web and a headbox feed pump P₄ is associated with said line 20. The surface layers of a multi-layer web are formed from the stock flows passed from the inlet headers J₁ and J₃, the surface layers of the multi-layer web being formed from the first fraction which is formed of the stock taken as accept from the fractionation screen and, in addition, of the stock taken as accept from the centrifugal cleaner of the first centrifugal cleaning stage of the centrifugal cleaning plant. In the embodiment of Fig. 3A, the fractionation screen 21 is situated in the feed line 14 of the centrifugal cleaner 15a₁ of the centrifugal cleaning stage Po_I .

In the embodiment of Fig. 3B, a headbox 100 comprises only inlet headers J_1 and J_2 . Otherwise the structure corresponds to the embodiment shown in Fig. 3A. The layer of a multi-layer web which forms the first fraction is formed of a web, such as a paper stock, which is composed of the stock that has passed through a fractionation screen and passed as accept from it and of the stock passed as accept from a centrifugal cleaner of the centrifugal cleaning plant. Thus, said layer forms one surface layer. The other layer, which is thus also a surface layer, as shown in Fig. 3B, is formed of the stock which is passed as accept from a lower stage of the centrifugal cleaning plant and to which at least part of the reject flow of the fractionation screen 21 is passed.

Fig. 4 shows an embodiment which is suitable in particular for the manufacture of SC paper. Kaolin is used, in addition to precipitated calcium carbonate (PCC), as a filler in SC paper since precipitated calcium carbonate alone is difficult to control. Fractionating lighter-coloured precipitated calcium carbonate to the surface layer of paper and kaolin to the middle layer provides an advantage in the brightness of paper.

In the first fractionation stage, the stock is fed to a screen fractionator, whose accept fraction containing fillers and fines is passed to the second fractionation stage, in which fine PCC and fines are separated from platy kaolin. The second fractionation stage is advantageously carried out by means of a fractionation hydrocyclone. PCC and fines are passed together with the accept fraction to the surface layer of a paper web and kaolin is passed together with the reject to the middle layer of paper. At the centrifugal cleaning plant, conformable fibres of chemical pulp are fractionated in the second centrifugal cleaning stage from the reject of the screen to accept and further to the surface layer of paper.

Precipitated calcium carbonate, fines and long chemical pulp fibres are passed to the surface layers of paper by means of the fractionation arrangement. Platy

kaolin is passed to the middle layer of paper. This arrangement improves the brightness, strength and printing properties of paper.

As shown in Fig. 4, the stock is passed from a wire pit 11 through a line 14 and by means of a pump P_1 to a screen 21, from which accept is passed through a line 14a₁ to a first centrifugal cleaner 15a₁ of a first centrifugal cleaning stage Po_I of a centrifugal cleaning plant 15.

A reject line 23 leads from the screen 21 to a centrifugal cleaner 15a₂ of a second centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant. Accept from the centrifugal cleaner 15a₁ is passed from the centrifugal cleaner 15a₁ of the first centrifugal cleaning stage Po_I of the centrifugal cleaning plant through a line 17 to a multi-layer headbox 100 to form a layer, advantageously a surface layer, of a multi-layer web. Similarly, accept from the second centrifugal cleaner 15a₂ is passed to the line 17 through a line 200 and the reject of said centrifugal cleaner 15a₂ is passed through a line 190 to a reject line 160 of the first centrifugal cleaner 15a₁. The line 160 is arranged to lead further to the multi-layer headbox 100 to form a layer, advantageously a middle layer, of the multi-layer web.

The line 17 is branched into branch lines 17a₁ and 17a₂ leading to inlet headers J_1 and J_3 of the multi-layer headbox, through which inlet headers the stock is passed to form the surface layers of the multi-layer web. The line 160 is arranged to lead to a middle inlet header J_2 of the multi-layer headbox to form the middle layer of the web. An embodiment is also feasible by which a web with merely two layers is manufactured. In that case, the line 17 is arranged to lead directly to the inlet header J_1 and the line 160 is arranged to lead to the inlet header J_2 to form a two-layer web. Otherwise the embodiment corresponds to the embodiment of Fig. 4.

Fig. 5 shows an embodiment in which the first fractionation stage is accomplished by means of a fractionation centrifugal cleaner 15a₁. The accept fraction is passed forward from it to a machine screen 21, the accept of which is passed to a surface

layer of paper. The reject fraction of the first fractionation stage is passed to a centrifugal cleaner 15a₂, the accept fraction of which is passed to the second fractionation stage, which is accomplished by means of a second screen fractionator 21a₂, the accept fraction of which is passed to the middle layer of paper. Reject from said second fractionation stage and the screen 21a₂ and reject from the machine screen 21 are passed to a third screen 21a₃, the accept of which is passed again to the second fractionation stage.

As shown in Fig. 5, the stock is supplied from a wire pit 11 to a line 14 and passed by means of a pump P₁ to the first centrifugal cleaner 15a₁ of a first centrifugal cleaning stage Po_I of a hydrocyclone apparatus 15. Accept from the centrifugal cleaner 15a₁ is passed through a line 17 to the screen 21, the accept of which is passed through a line 22 to branch lines 22a₁, 22a₂ and to inlet headers J₁ and J₃ of a multi-layer headbox to form a layer of a multi-layer web and, in the embodiment of Fig. 5, advantageously surface layers. Reject from the centrifugal cleaner 15a₁ is passed along a reject line 18 to form the feed of the second centrifugal cleaner 15a₂, the accept of which is passed along a line 20 as feed to the second screen 21a₂, from which the accept of the screen 21a₁ is passed further along a line 20a to an inlet header J₂ of the multi-layer headbox and to form a layer of a multi-layer web, in the embodiment of Fig. 5, advantageously a middle layer. A reject line 23 is arranged to lead from the screen 21 and join a reject line 23a₂ of the screen 21a₂ leading further to the third screen 21a₃, the accept of which is passed as feedback 24 back to the inlet line 20 leading to the second screen 21a₂.

Reject from a second centrifugal cleaning stage Po_{II} of the centrifugal cleaning plant 15 is passed along a reject line 18b to a third centrifugal cleaning stage Po_{III} of the centrifugal cleaning plant and there is an accept line 18c and a reject line 18d from a centrifugal cleaner 15a₃ of said centrifugal cleaning stage Po_{III}. The reject line 18d may lead to an exhaust or to further treatment, and the accept line 18c may be connected with a plant for further treatment of the stock. Within the scope of the invention, an embodiment is, of course, feasible by which merely a

two-layer web is manufactured. In that case, the line 22 leads directly to the inlet header J_1 and the line 20a leads to a second inlet header J_2 to form a two-layer web. The embodiment corresponds otherwise to the embodiment shown in Fig. 5.

5 The embodiments of Figs. 1A, 1B, 2, 3A, 3B, 4 and 5 described above disclose a method in fractionation of the stock fed to a paper machine or equivalent, in which the stock fed to the paper machine or equivalent has been diluted with wire water and pumped forward in the short circulation of the paper machine or equivalent.

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In the arrangement in accordance with the invention, a multi-layer web is advantageously formed by a multi-layer headbox 100 comprising different inlet headers J_1, J_2, J_3 for forming different web layers. The stocks are passed from the inlet headers through the tube banks of the headbox further onto a forming wire to
15 form said different web layers. The inlet headers J_1, J_2, J_3 are in different layers one upon the other in the multi-layer headbox 100.

In the method, the stock is passed to the first fractionation stage, in which the stocks are divided into at least two component stocks which differ from one
20 another, and both component stocks are passed to the second fractionation stage, in which fractionation is accomplished by a fractionation method that differs from the first fractionation. In the second fractionation stage, the stock is divided into at least two component stocks which differ from one another, so that the component stocks obtained from the first and the second fractionation stage are fed forward to
25 the different layers of a multi-layer headbox of a paper machine or equivalent.

The first and the second fractionation stage can be accomplished either by means of centrifugal cleaners which separate the pulp, for example, based on density, size, shape and surface roughness, or by means of screens which separate the pulp
30 based on its size.

A paper machine or equivalent refers to paper, board and tissue paper machines.

Fig. 6A is an illustration of principle of the centrifugal cleaner 15a₁ of the centrifugal cleaning plant used in the apparatus in accordance with the invention.

5 The stock is passed through an inlet line to the upper part of the centrifugal cleaner, which is a conical structure. Advantageously, the stock is passed tangentially to the upper part of the centrifugal cleaner and the stock spirals downward, so that the heaviest particles are separated to the periphery of the cone of the centrifugal cleaning plant and carried to the bottom of the cone, and lighter
10 particles are passed from the middle area along an accept line out of the upper part of the cone. The reject is passed from the bottom of the cone to a reject line.

Fig. 6B is an illustration of principle of one screen fractionation device which can be used in the fractionation and in the apparatus in accordance with the invention.

15 The screen fractionation device 21 comprises an inlet line in the middle area of the screen. The wings inside the screening wire mesh are rotated and the stock is passed through the screening wire mesh further to an accept line and separated material is passed away from the middle of the screening wire mesh through a reject line. One embodiment of principle of the screen has been illustrated.

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The fractionation apparatus in accordance with the invention can also be applied such that the different pulp components used for the manufacture of paper are fractionated separately and their desired fractions are combined before an inlet header of a multi-layer headbox to provide a desired stock composition for a
25 certain layer of a multi-layer web. Figs. 7 and 8 show two embodiments of the invention in which chemical pulp and mechanical pulp, such as thermomechanical pulp (TMP), are used as raw material of paper.

In Fig. 7, a dilute stock suspension formed of mechanical pulp and broke is passed
30 along a line 14 by means of a pump P₁ to a fractionation screen 21. The accepted fraction is passed through a line 14a₁ to a line 30 which conducts diluted chemical

stock to a paper machine. The stock is passed further by means of a pump P_3 to a first centrifugal cleaner 15a₁ of a first centrifugal cleaning stage Po_I . Accept from the centrifugal cleaner 15a₁ is passed through a line 17 to branch lines 17a₁ and 17a₂ and further to inlet headers J_1 and J_3 of a multi-layer headbox 100 to form the surface layers of a multi-layer web. The rejected fraction is passed from the fractionation screen 21 by means of a pump P_2 along a reject line 23 to a centrifugal cleaner 15a₂ of a second centrifugal cleaning stage Po_{II} . Accept from the centrifugal cleaner 15a₂ is passed through a line 20 to an inlet header J_2 of the multi-layer headbox 100 to form the middle layer of the multi-layer web.

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Fig. 8 shows an embodiment in which a dilute stock composition formed of mechanical pulp and broke is passed to a fractionation screen 21, from which the accepted fraction is passed through a line 14a₁ to a first centrifugal cleaner 15a₁ of a first centrifugal cleaning stage Po_I , accept from said centrifugal cleaner being passed along a line 17c to a line 17 leading to the headbox. The chemical pulp coming to the paper machine is first passed along a line 30 to a centrifugal cleaner 15a₃ of chemical pulp, the accept of which is passed along a line 17b to a line 17 leading to the headbox and the reject of which is passed along a line 31 to the line 23, which takes reject from the fractionation screen 21 to a first centrifugal cleaner 15a₂ of a second centrifugal cleaning stage Po_{II} .

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When mechanical pulp and broke are fractionated in the short circulation, the fines and fillers coming from wire water are also fractionated. By fractionating mechanical pulp separately from chemical pulp, a more effective fractionation result is obtained for the mechanical pulp. The chemical pulp can also be fractionated at a desired ratio for different layers of the multi-layer web but the fractionation of it is not as effective as that of the mechanical pulp.

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Claims

1. A fractionation apparatus in the short circulation of a paper machine or equivalent, which apparatus comprises in the short circulation (10) of the paper machine or equivalent a centrifugal cleaning plant (15) from which a stock flow is passed as accept to at least one inlet header (J_1) of a multi-layer headbox (100) of the paper machine to form one layer of a multi-layer web, and in which fractionation apparatus a diluted stock flow is passed to the centrifugal cleaning plant (15), **characterized** in that the fractionation apparatus comprises a fractionation screen (21) in connection with a centrifugal cleaner ($15a_1$) of a centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15), and that by means of the fractionation apparatus one first layer of the web is formed out of stock which is formed of stock passed as accept from the centrifugal cleaner ($15a_1$) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15) and, in addition, of stock passed as accept from the fractionation screen (21), and that at least one second layer of the multi-layer web is formed out of a second fraction which is formed of stock passed from a centrifugal cleaner ($15a_1$) of some lower centrifugal cleaning stage of the centrifugal cleaning plant (15), which stock comprises, in addition, a stock portion passed as reject from the above-mentioned fractionation screen (21) through a reject line (23 and/or 24). (FIG. 1A, FIG. 1B, FIG. 2, FIG. 3A, FIG. 3B, FIG. 4, FIG. 5)
2. A fractionation apparatus, **characterized** in that a fractionation screen (21) is disposed in an accept line (17) of a centrifugal cleaner ($15a_1$) of a first centrifugal cleaning stage (Po_I) of a centrifugal cleaning plant (15). (FIG. 1A, FIG. 1B)
3. A fractionation apparatus as claimed in claim 1 or 2, **characterized** in that a reject line (24) of the fractionation screen (21) is connected with a feed line (18) of a second centrifugal cleaning stage (Po_{II}) of the centrifugal cleaning plant (15) and/or through a line (23) directly with an accept line of a centrifugal cleaner ($15a_2$) of said second centrifugal cleaning stage (Po_{II}). (FIG. 1A, FIG. 1B)

4. An apparatus as claimed in the preceding claim, **characterized** in that an accept line (20) is arranged to lead from the middle of the centrifugal cleaner (15a₂) of the second centrifugal cleaning stage (Po_{II}) of the centrifugal cleaning plant (15) so as to form the second fraction and, from the upper part of the centrifugal cleaner (15a₂) of the centrifugal cleaning stage (Po_{II}) of the centrifugal cleaning plant, from its location which is further in than the location where the accept line (20) is connected with the centrifugal cleaner (15a₂), a light reject is passed through a line (201) to a feed line (14) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15), advantageously to the suction side of a stock feed pump (P₁) situated in the feed line (14). (FIG. 2)

5. An apparatus as claimed in claim 1, **characterized** in that the fractionation screen (21) has been disposed in a feed line (14) of the centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15). (FIG. 3A, FIG. 3B)

6. An apparatus as claimed in the preceding claim, **characterized** in that the fractionation screen (21) is disposed on the pressure side of a stock feed pump (P₁) in the feed, or inlet, line (14) of the centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I). (FIG. 3A, FIG. 3B)

7. An apparatus as claimed in claim 5 or 6, **characterized** in that the fractionation screen (21) has been connected by its accept line (14a₁) so as to form an inlet line of the centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15) and/or reject from the fractionation screen (21) is passed to a feed line (18) of another centrifugal cleaning stage (Po_{II}) of said centrifugal cleaning plant (15), and/or directly so as to form the second fraction by connecting a reject line (22) with an accept line (20) of the centrifugal cleaner (15a₂) of another centrifugal cleaning stage (Po_{II}) of said centrifugal cleaning plant. (FIG. 3A, FIG. 3B)

8. An apparatus as claimed in any one of the preceding claims, **characterized** in that there is a line (17, 22) through which accept from the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant is passed from the hydrocyclone cleaner (15a₁), which line (17, 22) delivers the first fraction to an inlet header (J₁) of the multi-layer headbox (100) to form a surface layer of the multi-layer web, or that there is a line (17, 22) which has been branched into two branch lines (17a₁, 17a₂, 22a₁, 22a₂) arranged to lead to inlet headers (J₁, J₃) of the headbox (100) to form the surface layers of the multi-layer web, and that there is additionally an accept line (20) from some other centrifugal cleaner (15a₂) of a centrifugal cleaning stage (Po_{II}) of said centrifugal cleaning plant (15), so that one other layer of multi-layer paper is formed out of the second fraction, which has been passed from said centrifugal cleaning stage (Po_{II}) along the line (20) and which second fraction comprises stock that contains reject passed from the fractionation screen (21).

9. An apparatus as claimed in claim 1, **characterized** in that in the apparatus arrangement there is a line (14) from a wire pit (11) or equivalent to the screen (21) from which accept is passed through a line (14a₁) to the centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15), and in which apparatus arrangement a reject line (23) is arranged to lead from the screen (21) to the centrifugal cleaner (15a₂) of the second centrifugal cleaning stage (Po_{II}) of the centrifugal cleaning plant, and in which apparatus arrangement the accept of the centrifugal cleaner (15a₁) is passed from the centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant through a line (17) to the multi-layer headbox (100) to form a surface layer/surface layers of a multi-layer web. (FIG. 4)

10. An apparatus as claimed in the preceding claim, **characterized** in that in the apparatus arrangement the accept of the centrifugal cleaner (15a₂) of the second centrifugal cleaning stage (Po_{II}) is passed to the line (17) along a line (200), and

that the reject of said centrifugal cleaner (15a₂) is passed through a line (190) to a reject line (160) of the first centrifugal cleaner (15a₁), and that in the apparatus arrangement the line (160) is arranged to lead to an inlet header (J₂) of the multi-layer headbox (100) and to form a layer of the web, advantageously its middle layer. (FIG. 4)

11. An apparatus as claimed in the preceding claim, **characterized** in that the line (17) is branched into branch lines (17a₁, 17a₂) leading to inlet headers (J₁, J₂) of the multi-layer headbox, through which inlet headers the stock is passed to form the surface layers of the multi-layer web. (FIG. 4)

12. An apparatus as claimed in claim 1, **characterized** in that from a wire pit (11) or equivalent there is a line (14) which is arranged to lead to the first centrifugal cleaner (15a₁) of the first centrifugal cleaning stage (Po_I) of the centrifugal cleaning plant (15), and that accept from said centrifugal cleaner (15a₁) is passed along the line (17) to the screen (21), from which screen (21) accept is passed along a line (22) and branch lines (22a₁, 22a₂) to inlet headers (J₁, J₂) of the multi-layer headbox (100) to form the surface layers or at least one surface layer of the multi-layer web, and that a reject line (18) is arranged to lead from the centrifugal cleaner (15a₁) to form the feed to the centrifugal cleaner (15a₂) of the second centrifugal cleaning stage (Po_{II}), from which accept is passed along a line (20) as feed to a screen (21a₂), and from which screen (21a₂) accept is passed through a line (20a) to an inlet header (J₂) of the multi-layer headbox to form one other layer, advantageously a middle layer, of the multi-layer web. (FIG. 5)

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13. An apparatus as claimed in the preceding claim, **characterized** in that from the screen (21) there is a reject line (23) to a reject line (23a₂) of the second screen (21a₂), which reject line leads further to a third screen (21a₃), whose accept line (24) is connected as feedback to the inlet line (20) leading to the screen (21a₂). (FIG. 5)

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14. A method in fractionation of stock fed to a paper machine or equivalent, in which the stock fed to the paper machine or equivalent has been diluted with wire water and pumped forward in the short circulation of the paper machine or equivalent, **characterized** in that, in the method, the stock is passed to a first
5 fractionation stage in which the stocks are divided into at least two component stocks which differ from one another, and both component stocks are passed to a second fractionation stage in which fractionation is accomplished by a fractionation method which differs from the first fractionation, and in the second fractionation stage the stock is divided into at least two component stocks which
10 differ from one another, so that the component stocks obtained from the first and the second fractionation stage are fed forward to different layers of a multi-layer headbox of the paper machine or equivalent.

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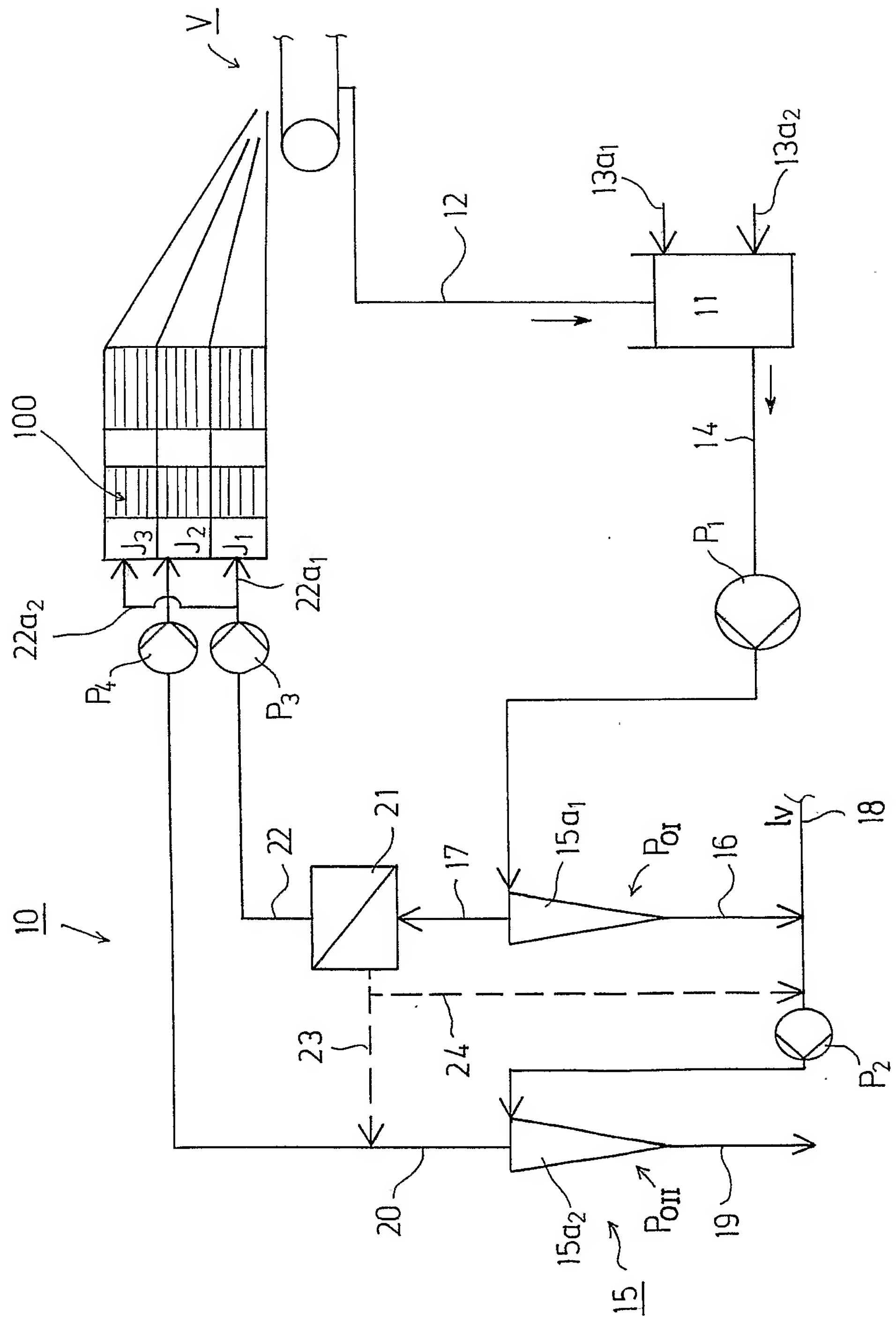


FIG. 1A

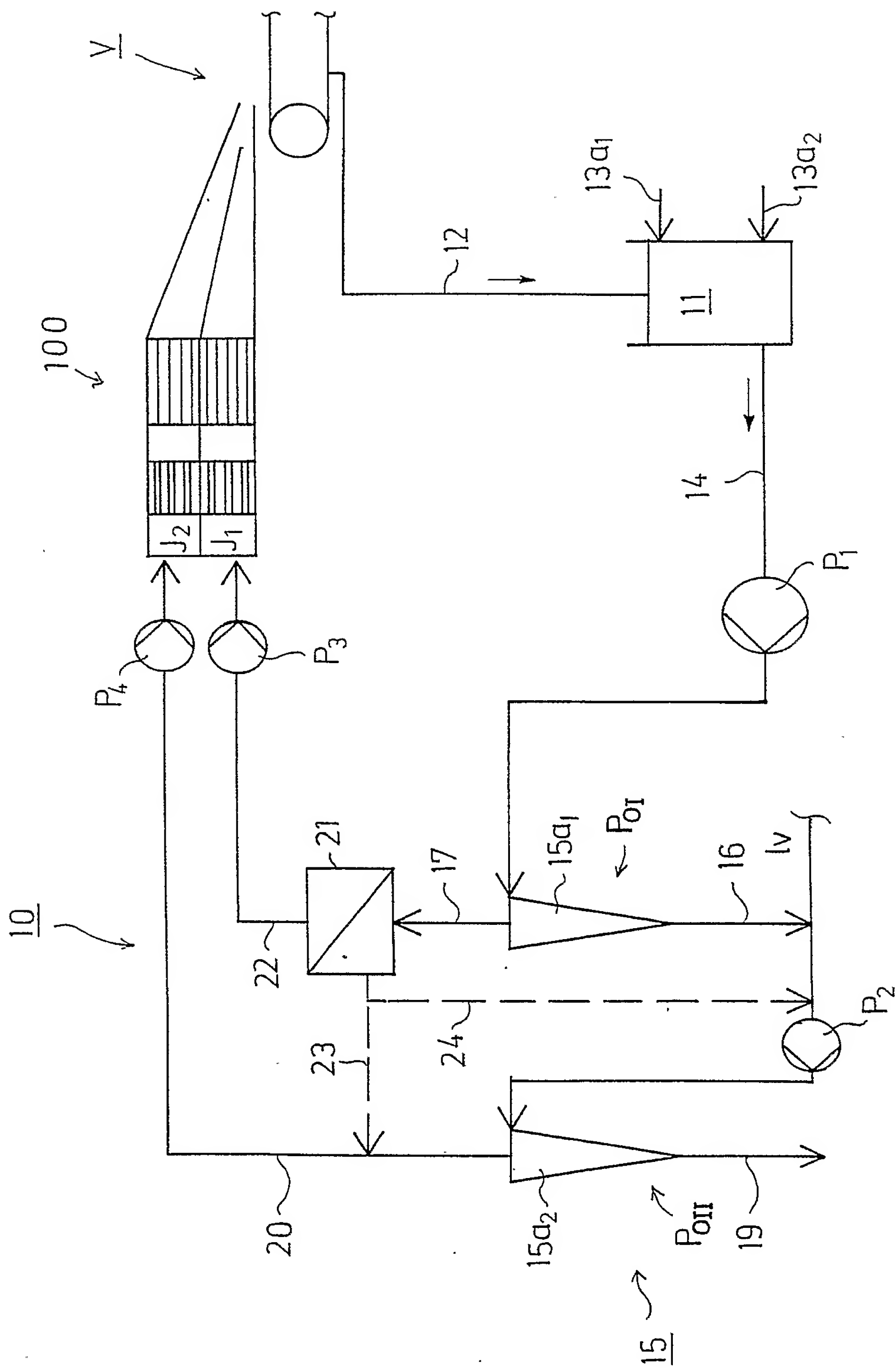
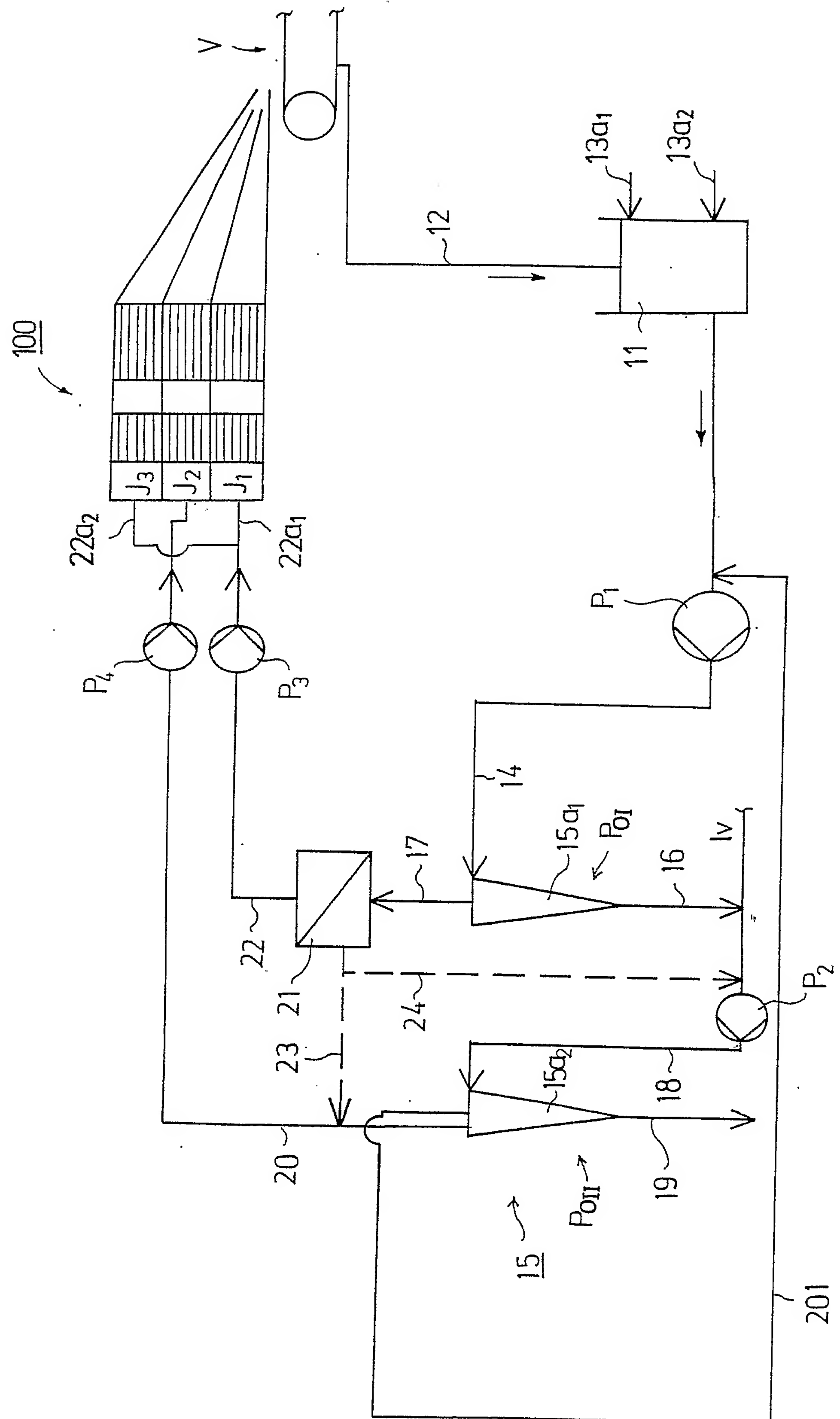


FIG. 1B

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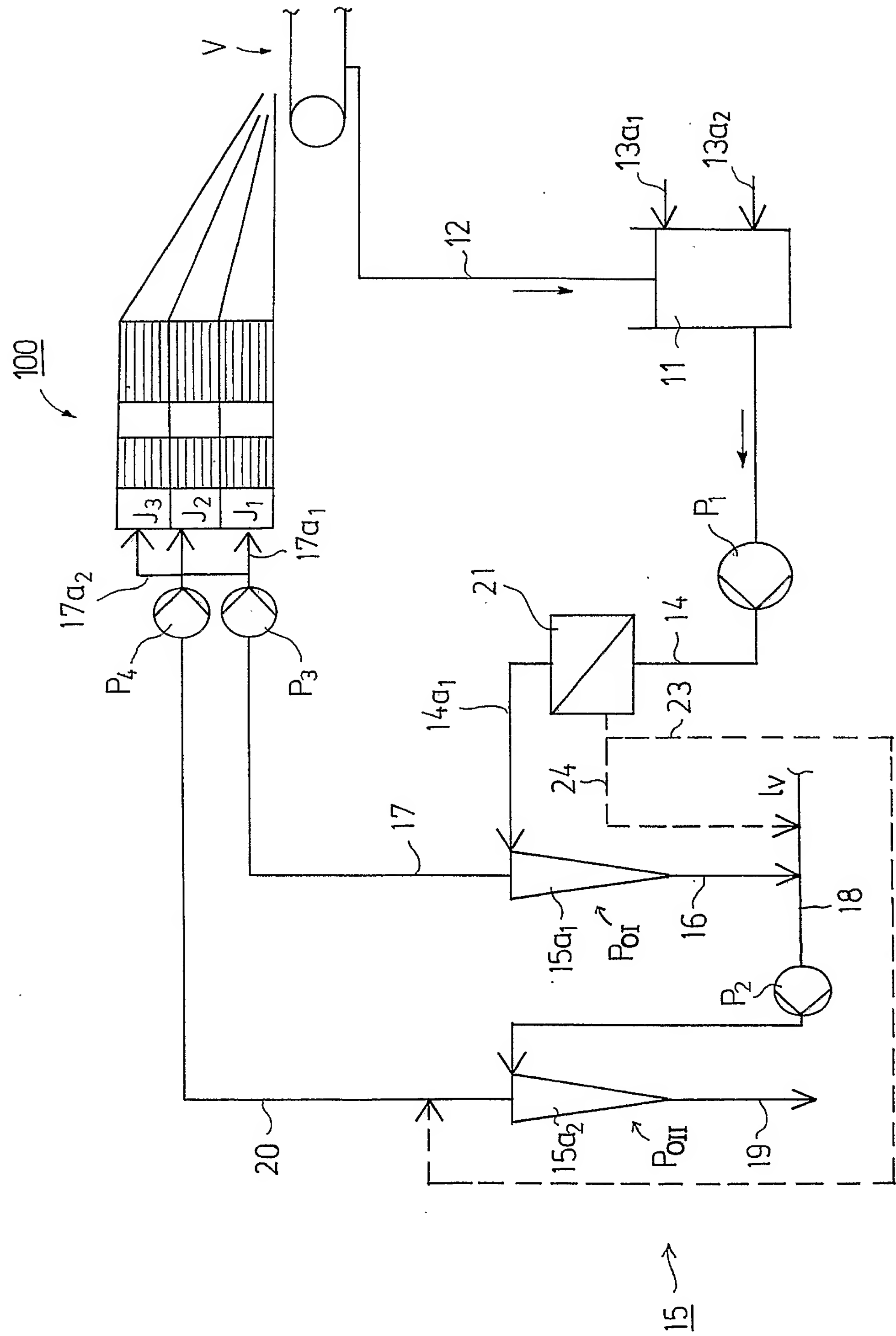
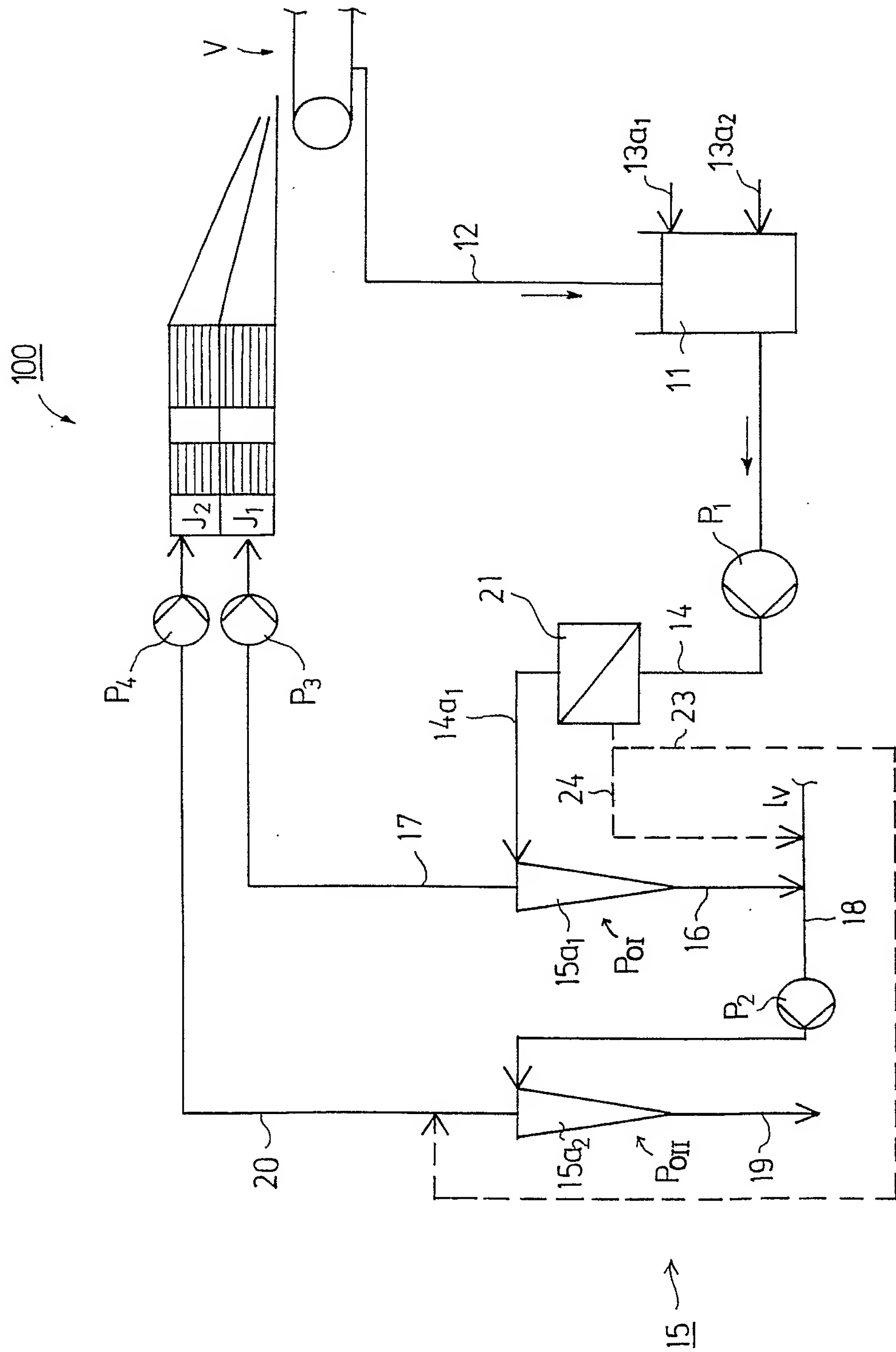


FIG. 3A



FB3

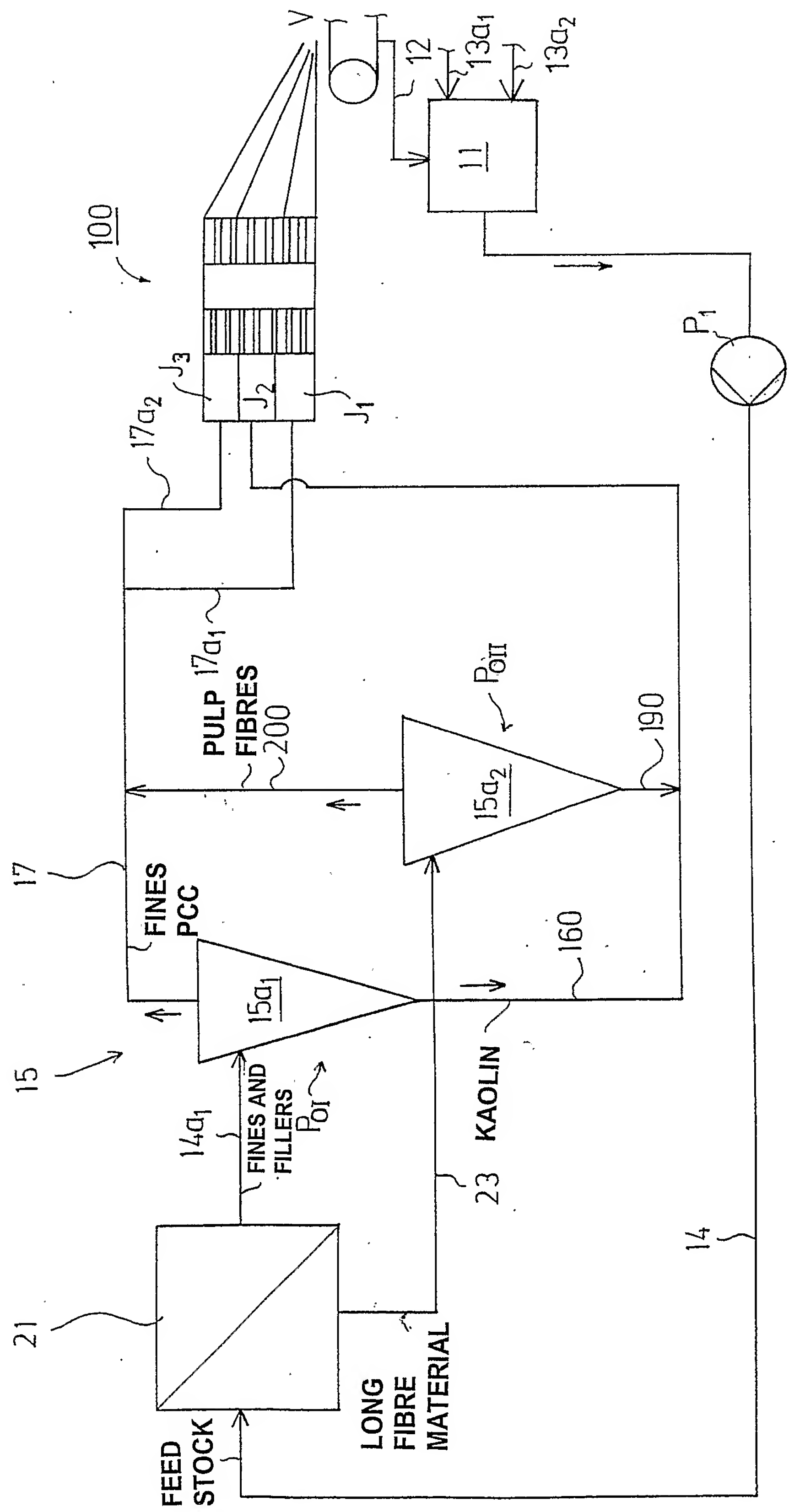


FIG.4

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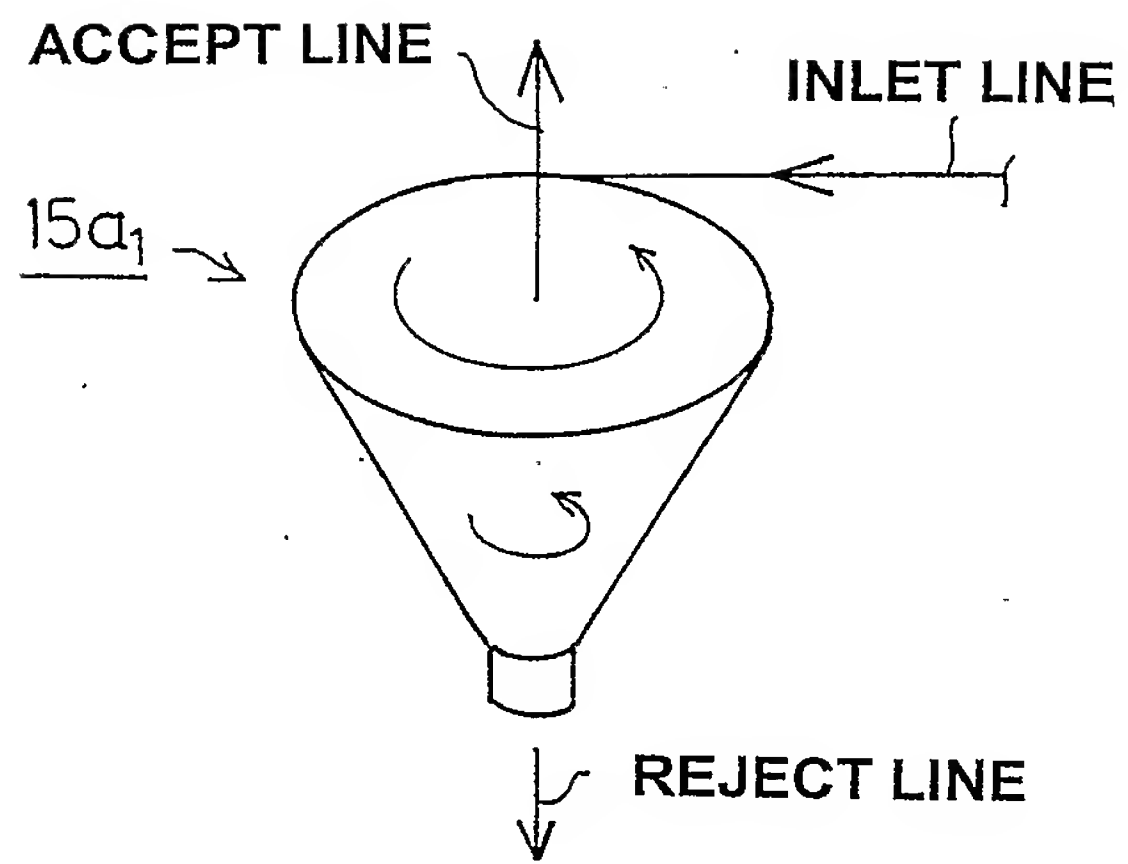


FIG. 6A

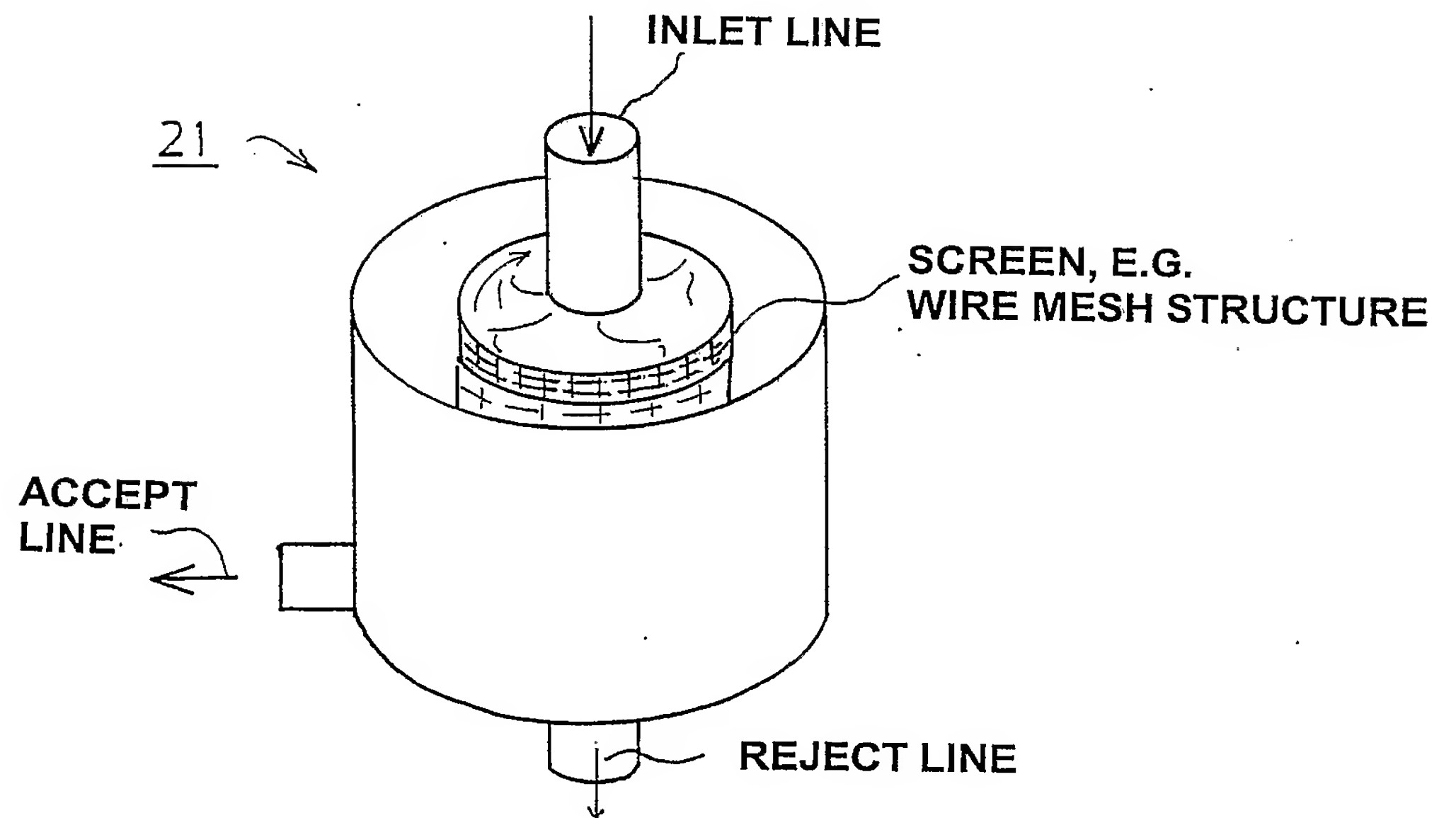


FIG. 6 B

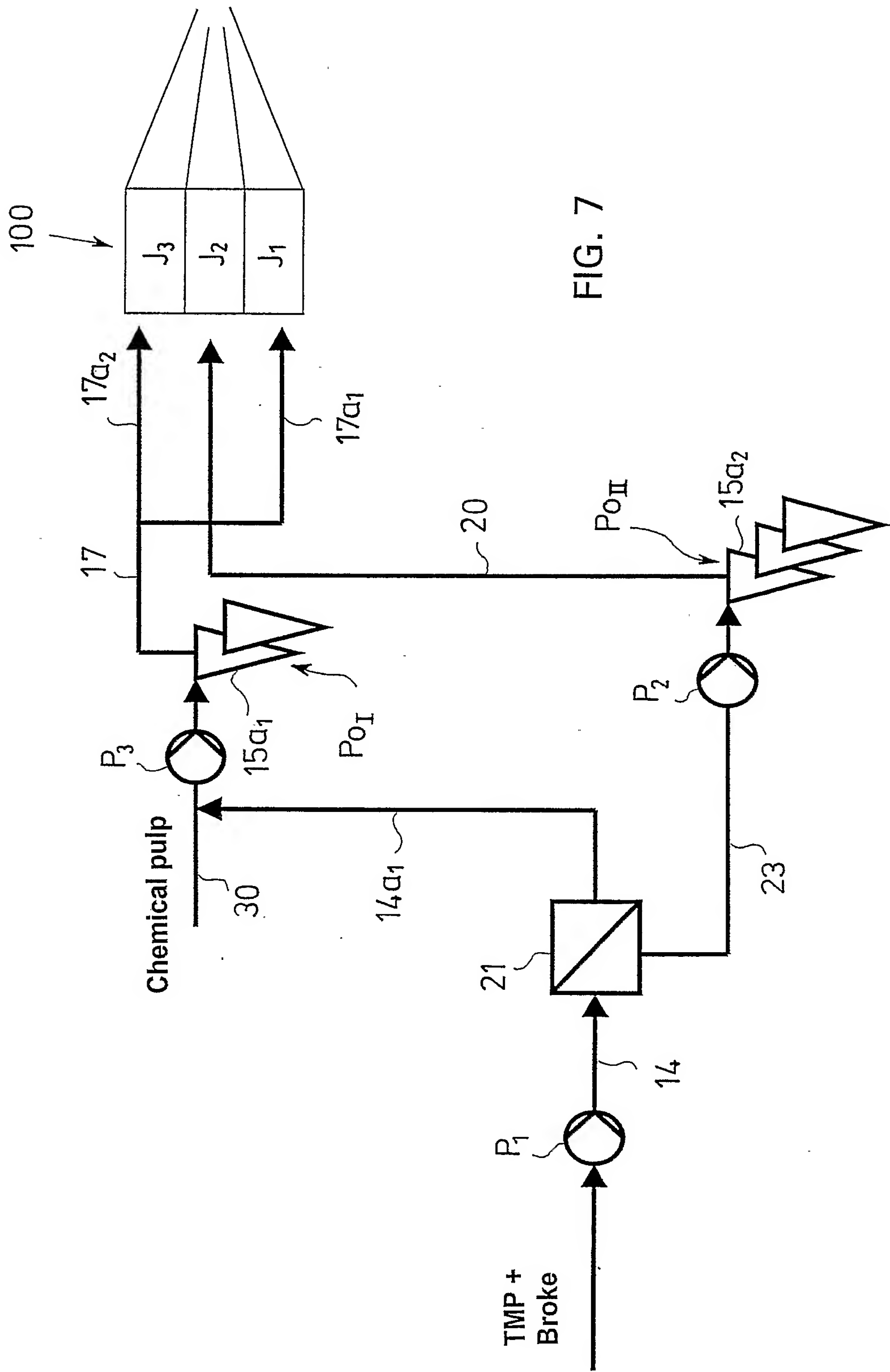


FIG. 7

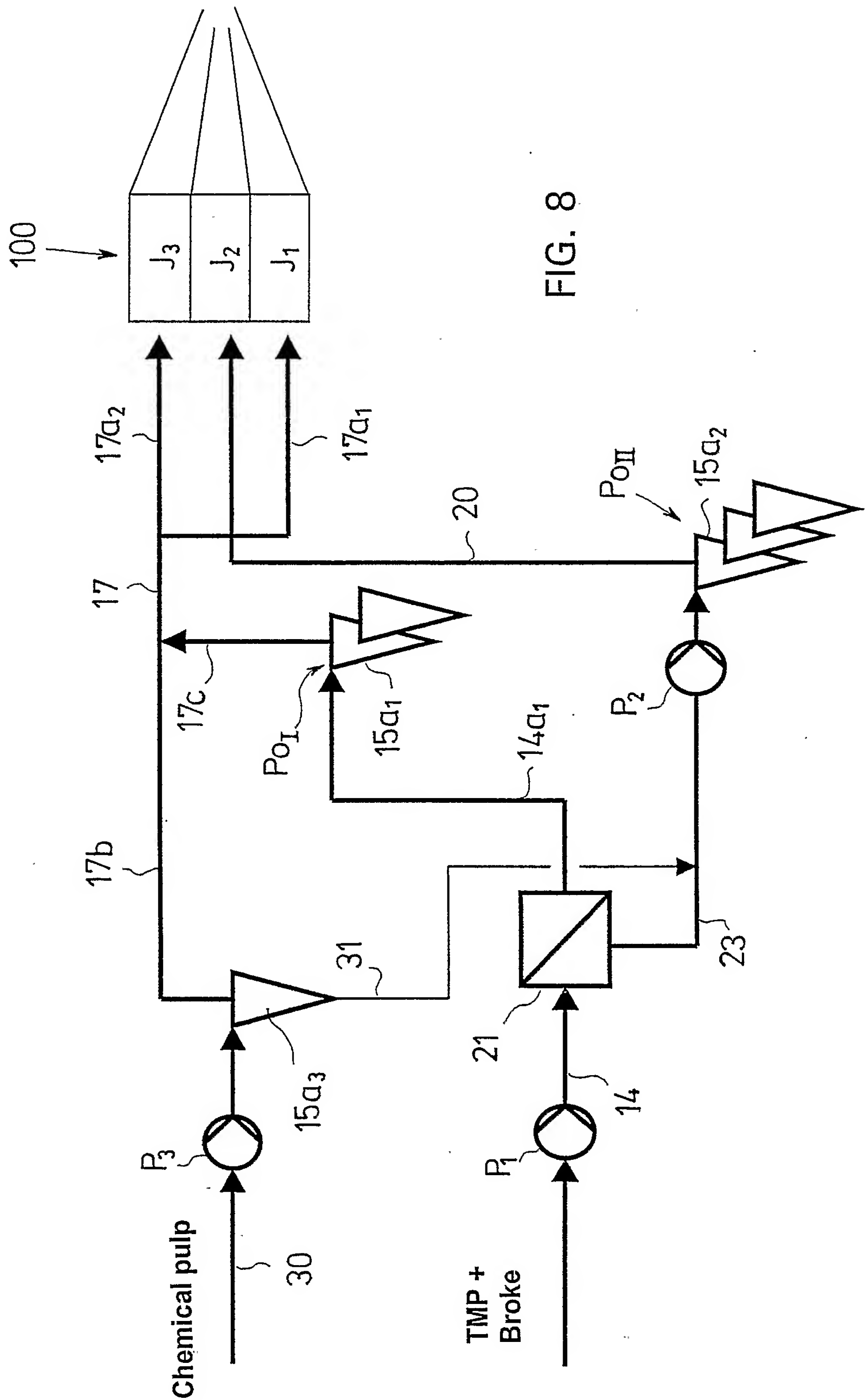


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 03/00444

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21D 5/00, D21F 1/68, D21F 11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21D, D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19526205 A1 (VOITH SULZER STOFFAUFBEREITUNG GMBH), 30 January 1997 (30.01.97), column 3, line 28 - line 53, figure 3, claim 12 -- -----	1,14

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 July 2003

Date of mailing of the international search report

31 -07- 2003

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Information on patent family members

29/06/03

International application No.

PCT/FI 03/00444

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE	19526205 A1	30/01/97	NONE
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